even then, Viterbi and Jacobs were experimenting with a Shannonesque technology.

A classic example of the efficacy of wide and weak, CDMA exploits the resemblance between noise and information. The system began in the military as an effort to avoid jamming or air-tapping of combat messages. Qualcomm brings CDMA to the challenge of communications on the battlefronts of big-city cellular.

Rather than compressing each call into between three and 10 tiny TDMA time slots in a 30-kilohertz cellular channel, Qualcomm's CDMA spreads a signal across a comparatively huge 1.25-megahertz swath of the cellular spectrum. This allows many users to share the same spectrum space at one time. Each phone is programmed with a specific pseudonoise code, which is used to stretch a low-powered signal over a wide frequency band. The base station uses the same code in inverted form to "despread" and reconstitute the original signal. All other codes remain spread out, indistinguishable from background noise.

Jacobs compares TDMA and CDMA to different strategies of communication at a cocktail party. In the TDMA analogy, each person would restrict his or her talk to a specific time slot while everyone else remains silent. This system would work well as long as the party was managed by a dictator who controlled all conversations by complex rules and a rigid clock. In CDMA, on the other hand, everyone can talk at once but in different languages. Each person listens for messages in his or her own language or code and ignores all other sounds as background noise. Although this system allows each person to speak freely, it requires constant control of the volume of the speakers. A speaker who begins yelling can drown out surrounding messages and drastically reduce the total number of conversations that can be sustained.

Thus, it was in the name of competitiveness and technological progress, and of keeping up with the Europeans and Japanese, that the U.S. moved to embrace an obsolescent cell dat system.

For years, this problem of the stentorian guest crippled CDMA as a method of increasing the capacity of cellular systems. Spread spectrum had many military uses because its unlocalized signal and cryptic codes made it very difficult to jam or overhear. In a cellular environment, however, where cars continually move in and out from behind trucks, buildings and other obstacles, causing huge variations in power, CDMA systems would be regularly swamped by stentorian guests. Similarly, nearby cars would tend to dominate faraway vehicles. This was termed the near-far problem. When you compound this challenge with a static of multipath signals causing hundreds of 10,000-to-1 gyrations in power for every foot traveled by the mobile unit—so-called Rayleigh interference pits and spikes—you can comprehend the general incredulity toward CDMA among cellular cognoscenti. Indeed, as recently as 1991, leading experts at Bell Labs, Stanford University and Bellcore confidently told me the problem was a show-stopper; it could not be overcome.

Radio experts, however, underestimate the power of the microcosm. Using digital signal processing, error correction and other microcosmic tools, wattage spikes and pits 100 times a second can be regulated by electronic circuitry that adjusts the power at a rate of more than 800 times a second.

To achieve this result, Qualcomm uses two layers of controls. First is a relatively crude top layer that employs the automatic gain control device on handsets to constantly adjust the power sent by the handset to the level of power received by it from the base station. This rough adjustment does not come near to solving the problem, but it brings a solution into reach by using more complex and refined techniques.

In the second power-control step, the base station measures the handset's signal-to-noise and bit-error ratios once every 1.25 milliseconds (800 times a second). Depending on whether these ratios are above or below a constantly recomputed threshold, the base station sends a positive or negative pulse, either raising or lowering the power some 25 percent.

DYNAMIC CELLS

Passing elaborate field tests with flying colors, this power-control mechanism has the further effect of dynamically changing the size of cells. In a congested cell, the power of all phones rises to overcome mutual interference. On the margin, these high-powered transmissions overflow into neighboring cells where they may be picked up by adjacent base station equipment. In a quiet cell, power is so low that the cell effectively shrinks, transmitting no interference at all to neighboring cells and improving their performance. This kind of dynamic adjustment of cell sizes is impossible in a TDMA system, where adjacent cells use completely different frequencies and fringe handsets may begin to chirp like Elmer Fudd.

Once the stentorian voice could be instantly abated, power control changed from a crippling weakness of CDMA into a commanding asset. Power usage is a major obstacle to the PCN future. All market tests show that either heavy or short-lived batteries greatly reduce the attractiveness of the system. Because the Qualcomm feedback system keeps power always at the lowest feasible level, batteries in CDMA phones actually are lasting far longer than in TDMA phones. CDMA phones transmit at an average of two milliwatts, compared with 600 milliwatts and higher for most other cellular systems.

A further advantage of wide and weak comes in handling multipath signals, which bounce off obstacles and arrive at different times at the receiver. Multipath just adds to the accuracy of CDMA. The Qualcomm system combines the three strongest signals into one. Called a rake receiver and co-invented by Paul Green, currently at IBM and author of *Fiber Optic Networks* (Prentice Hall, 1992), this combining function works even on signals from different cells and thus facilitates hand-offs. In TDMA, signals arriving at the wrong time are pure interference in someone else's time slot; in CDMA, they strengthen the message.

A further advantage of wide and weak comes in handling multipath signals, which bounce off obstacles and arrive at different times at the receiver. Multipath just adds to the accuracy of CDMA

Finally, CDMA allows simple and soft hand-offs. Because all the phones are using the same spectrum space, moving from one cell to another is easy. CDMA avoids all the frequency juggling of TDMA systems as they shuffle calls among cells and time slots. As the era of PCN microcells approaches, this advantage will become increasingly crucial. Cellular systems that spurn Qualcomm today may find themselves in a quagmire of TDMA microcells tomorrow. Together, all the gains from CDMA bring about a tenfold increase over current analog capacity. In wireless telephony above all, wide and weak will prevail.

Like any obsolescent scheme challenged by a real innovation—and like minicomputers and mainframes challenged by the PC—TDMA is being sharply improved by its proponents. The inheritors of the Linkabit TDMA patents at Hughes and International Mobile Machines Corp. (IMMC) have introduced extended TDMA, claiming a 19-fold advance over current analog capacity. Showing a conventional cellular outlook, however, E-TDMA fatally adopts the idea of increasing capacity by lowering speech quality. This moves in exactly the wrong direction. PCN will not triumph through compromises based on a scarce-spectrum mentality. PCN will multiply bandwidth to make the acoustics of digital cellular even better than the acoustics of wire-line phones, just as the acoustics of digital CDs far excel the acoustics of analog records.

Riding the microcosmic gains of digital signal processing, CDMA inherently offers greater room for improvement than TDMA does. Bringing the computer revolution to cellular telephony, CDMA at its essence replaces frequency shuffling with digital intelligence. Supplanting the multiple radios of TDMA—each with a fixed frequency—are digital-signal-processing chips that find a particular message across a wide spectrum swath captured by one broadband radio.

With the advance in digital electronics, the advantage of CDMA continually increases. As the most compute-intensive system, CDMA gains most from the onrushing increases in the cost-effectiveness of semiconductor electronics. Qualcomm recently announced that it has reduced all the digital signal processing for CDMA into one application-specific chip.

For all the indispensable advances of CDMA, however, Qualcomm cannot prevail alone. It brilliantly executes the move to digital codes, but proprietary mainframe computer networks are digital, too. As presently conceived, CDMA still aspires to be a cellular standard using the same mainframe architecture of mobile telephone switching offices that now serve the analog cellular system. In itself the Qualcomm solution does little to move cellular toward the ever cheaper, smaller and more open architectures that now dominate network computing and will shape PCN.

Hearing Feathers Crash Amid Heavy Metal

Consummating the PCN revolution—with its millions of microcells around the globe and its myriad digital devices and frequencies—will require a fundamental breakthrough in cellular radio technology. In the new Steinbrecher minicell introduced early this month at the Cellular Telephone Industry Association show, that breakthrough is at hand. The first true PC server for PCN, this small box ultimately costing a few thousand dollars will both replace and far outperform a 1,000-square-foot base station costing more than a million dollars.

Once again, in an entrepreneurial economy, crucial innovations come as an utter surprise to all the experts in the field. Donald Steinbrecher began in the Radio Astronomy Lab at MIT in the 1960s and early 1970s, creating receivers that could resolve a random cosmic ray among a mass of electromagnetic noise. This required radios with huge dynamic range—radios that could hear a feather drop at a heavy metal rock concert. He and his students solved this intractable problem by creating unique high-performance receivers and frequency "mixers." These could process huge spans of spectrum with immense variations of power and translate them without loss into intermediate frequencies. Then, computer systems convert the signals from analog to digital and analyze them with digital signal processors.

Moving out to begin his own company in 1973, Steinbrecher and his colleagues made several inventions in the fields of radar and digital signal analysis. At first, most of their customers were national security contractors in the intelligence field. For example, Steinbrecher supplied the radios for the ROTHR (remote over the horizon radar) systems that became famous for their role in the war against airborne drug traffic. Then in 1986, the company was asked if its equipment could work in the cellular band.

After cosmic rays and battlefield radar, the cellular band was easy. When he saw that the digital signal processors at the heart of his systems were dropping in price tenfold every two years, Steinbrecher knew that his esoteric radios could become a consumer product.

Translated to cellular, this technology opens entire new frontiers for wireless telephony. Rather than tuning into one fixed frequency as current cellular radios do, Steinbrecher's cells can use a high-dynamic-range digital radio to down-convert and digitize the entire cellular band. TDMA, CDMA, near or far, analog cellular, video, voice or data, in any combination, it makes no difference to the Steinbrecher system. His minicell converts them all at once to a digital bit stream. The DSPs take over from there, sorting out the TDMA and CDMA signals from the analog signals and reducing each to digital voice. To the extent the Steinbrecher system prevails, it would end the need for hybrid phones and make possible a phased shift to PCN or a variety of other digital services.

Hoping to use Qualcomm chipsets and other technology, Steinbrecher could facilitate the acceptance of CDMA. For CDMA, the minicell provides a new, far cheaper radio front end that offers further relief to the near-far problem and is open to the diverse codes and fast-moving technologies of PCN. For the current cellular architecture, however, Steinbrecher offers only creative destruction, doing for large base stations what the integrated circuit did for racks of vacuum tubes in old telephone switches.

> *The future of wireless is boundless bandwidth, accomplished through the Shannon strategy of wide and weak signals, moving to ever smaller cells with lower power at higher frequencies.*

In essence, the new minicell replaces a rigid structure of giant analog mainframes with a system of wireless local area networks. Reconciling a variety of codes and technologies, the Steinbrecher devices resemble the smart hubs and routers from SynOptics Communications and Cisco Systems that are transforming the world of wired computer networks.

Best of all, at a time when the computer industry is preparing a massive invasion of the air, these wide and weak radios can handle voice, data and even video at the same time. Further, by cheaply accommodating a move from scores of large base stations to scores of thousands of minicells per city—on poles, down alleys or in elevator shafts—the system fulfills the promise of the computer revolution as a spectrum multiplier. Since each new minicell can use all the frequencies currently used by a large cell site, the multiplication of cells achieves a similar multiplication of bandwidth.

Finally, the Steinbrecher receivers can accommodate the coming move into higher frequencies. Banishing once and for all the concept of spectrum scarcity, these high-dynamic-range receivers can already handle frequencies up to the "W band" of 90 gigahertz and more.

Boundless Bandwidth

The future of wireless communications is boundless bandwidth, accomplished through the Shannon strategy of wide and weak signals, moving to ever smaller cells with lower power at higher frequencies. The PCN systems made possible by Qualcomm and Steinbrecher apply this approach chiefly to voice and data. Recent announcements by Bossard and Hovnanian extend the concept to television video as well. Last December, they disclosed that their company, Cellular Vision, was already wirelessly delivering 49 cable television channels to 350 homes near Brighton Beach, Long Island, in the 28-gigahertz band. They declared a plan to soon sign up some 5,000 new customers a month all over New York.

Among engineers in cellular and cable firms, Cellular Vision evokes the same responses of incredulity and denial familiar at Qualcomm and Steinbrecher. Like them, Bossard is resolutely on the right side of the Shannon and Shockley divide. In answer to the multitude of qualms and objections and demurrals, all three companies cite the huge benefits of more bandwidth. Qualcomm can assign some 416 times as much bandwidth to each call as a current cellular or TDMA system. Steinbrecher's minicell receivers can process 4,160 times as much bandwidth as an analog cell site or TDMA radio.

Hovnanian achieves some 300 times the bandwidth of a broadcast TV station and some three times the bandwidth of even a typical cable head end. For Hovnanian's so-called multipoint local distribution system, the FCC has allocated a total of two gigahertz between 27.5 and 29.5 gigahertz—one gigahertz for TV and one gigahertz for experimental data and phone service. This large swath of spectrum allows Cellular Vision to substitute bandwidth for power. Using FM rather than the AM system of cable, Cellular Vision gains the same kind of increased fidelity familiar in FM radio. Assigning 20 megahertz to each channel—three times the six megahertz of an analog system—Cellular Vision proves the potency of wide and weak by getting 20 decibels—some 10 times—more signal quality. These extra decibels come in handy in the rain.

> *As computer companies have already learned, phone and cable companies will discover that self-cannibalization is the only way to succeed in this era—the only way to stop others from capturing the prize.*

With a radius of three miles, Cellular Vision cells are about 100 times smaller than telephone cells. Transmitting only 10 milliwatts per channel over a three-mile radius, the system gets far better signal-to-noise ratios than the three-watt radios of cellular phones or the multikilowatt systems of AM radio or television broadcasts. The millimeter wavelengths at 28 gigahertz allow narrowband high-gain antennas that lock onto the right signal and isolate it from neighboring cells. At 28 gigahertz, small antennas command the performance of much larger ones (for example, a six-inch antenna at 28 gigahertz is equivalent to a three-foot antenna at 4 gigahertz or a 300-foot antenna at broadcast television frequencies).

In Brighton Beach the receiving antennas, using a fixed-phased-array technology, are just four inches square, and the transmitting antennas deliver 49 channels from a one-inch omnidirectional device on a box the size of a suitcase. Between cells, these transmitters can send programming and other information through a conventional point-to-point microwave link.

SINGING IN THE RAIN

So what happens in the rain? Well, it seems that Cellular Vision does better than conventional cable. When you have small cells in geodesic low-power wireless networks using the full computational resources of modern microchips, you have plenty of extra decibels in your signal-to-noise budget to endure the most violent storms. Indeed, the 350 Brighton Beach customers of Cellular Vision received continuous service during the November 1992 near hurricane in New York, which brought floods that interrupted many cable networks for hours. One competitive advantage of Cellular Vision over cable seems to be less vulnerability to water.

Moving television radically toward the regime of wide and weak, Bossard and the Hovnanians have changed the dimensions of the air. However, they cannot escape the usual burdens of the innovator. Any drastic innovation must be some 10 times as good as what it replaces. Otherwise, the installed base, engineering momentum and customer loyalty of the incumbents will prevail against it.

Cellular Vision faces a wired cable system with some $18 billion in installed base. Already deploying fiber at a fast pace, cable companies plan to move within the next year toward digital compression schemes that increase capacity or resolution by a factor of between six and 10 (depending on the character of the programming). That means some 500 digital channels or more. TCI, the leading cable company, has ordered some one million cable converter and decompression boxes from General Instruments' Jerrold subsidiary for delivery late in 1993. In the U.S. cable industry, Hovnanian faces an aggressively moving target. Most cable experts doubt he can make much of a dent.

This view may be shortsighted. Clearly, Cellular Vision—and its likely imitators—can compete in the many areas with incompetent cable systems, in areas yet unreached by cable or in new projects launched by developers such as the Hovnanians. In the rest of the world, cable systems are rare. Cellular Vision is finding rich opportunities abroad, from Latvia to New Zealand. Most of all, as time passes, Cellular Vision might find itself increasingly well positioned for a world of untethered digital devices.

Such a cellular system could be adapted to mobile telephone or computer services. With a bit-error rate of one in 10 billion, it could theoretically transmit computer data without error correction. With one gigahertz of bandwidth, the system could function easily as a backbone for PCN applications, collecting calls from handsets operating at lower frequencies and passing them on to telephone or cellular central offices or to intelligent network facilities of the local phone companies.

The future local loop will combine telephone, teleputer and digital video services, together with speech recognition and other complex features, in patterns that will differ from neighborhood to neighborhood. Easily customizable from cell to cell, a system like Bossard's might well offer powerful advantages.

In an era of bandwidth abundance, the Negroponte switch–with voice pushed to the air and video onto wires–may well give way to this division between fibersphere and atmosphere. With the fibersphere offering virtually unlimited bandwidth for fixed communication over long distances, the local loop will be the bottleneck, thronged with millions of wireless devices. Under these conditions, a move to high-frequency cellular systems is imperative to carry the increasing floods of digital video overflowing from the fibersphere.

In any case, led by Qualcomm, Steinbrecher and Cellular Vision, a new generation of companies is emerging to challenge the assumptions and structures of the existing information economy. All these companies are recent startups, with innovations entirely unexpected by international standards bodies, university experts and government officials. They are the fruit of an entrepreneurial America, guided by the marketplace into the microcosm and telecosm.

WHY IMITATE EUROPEAN FAILURES?

Meanwhile, the European and Japanese experiences with government-guided strategies should give pause to proponents of similar policies here. Thirty years of expensive industrial policy targeting computers has left the Europeans with no significant computer firms at all. The Japanese have done better, but even they have been losing market share across the board to the U.S.

In the converging crescendos of advance in digital wireless telephony and computing, progress is surging far beyond all the regulatory maps and guidebooks of previous years. If the entire capacity of the 28-gigahertz band, renewed every three miles, is open to telephony and video, bandwidth will be scarcely more limiting in wireless than it is in glass.

In this emerging world of boundless bandwidth, companies will prevail only by transcending the folklore of scarcity and embracing the full promise of the digital dawn. In an era of accelerating transition, the rule of success will be self-cannibalization. Wire-line phone companies are not truly profitable today; their reported earnings all spring from slow depreciation of installed plant and equipment that are fast becoming worthless. As George Calhoun of IMMC demonstrates in his superb new book, *Wireless Access and the Local Telephone Network* (Artech, 1992), new digital wireless connections are already less than one-third the cost of installing wire-line phones. For the RBOCs, aggressively attacking their own obsolescent enterprises is their only hope of prosperity.

As Joseph Schlosser of Coopers & Lybrand observes, self-cannibalization will not appear to be in the financial interests of the established firms; it will not prove out in net-present-value terms. There will be no studies to guarantee its success. Executives will have to earn their pay by going with their gut. As semiconductor and computer companies have already learned, phone and cable companies will discover that self-cannibalization is the only way to succeed in this era–the only way to stop others from capturing the heart of your business.

This is the lesson of the last decade. When Craig McCaw sold his cable properties and plunged into cellular telephony and $2 billion of Michael Milken's junk bond debt, there was no way to prove him right. Today AT&T is preparing to launch him as a rival to Bill Gates as the nation's richest man. Yet McCaw cannot rest on his laurels; the hour of the cannibal is at hand.

In theory, the transition should not be difficult for this resourceful and ingenious entrepreneur, who has long been a leading prophet of ubiquitous wireless phones and computers–his predicted personal digital assistant, "Charles." But a company that has paid billions for its 25-megahertz national swath of long and strong frequencies faces especially acute dilemmas in moving toward a regime of wide and weak. As a man–and company–that has made such transitions before, McCaw is favored by history and by AT&T. As a giant pillar of the new establishment, though, McCaw may find it as difficult to shift gears as did the computer establishment before him. The stakes are even higher. The next decade will see the emergence of fortunes in ever-changing transmutations of PCN, digital video, multimedia and wireless computers that dwarf the yields of cable and cellular. The window of opportunity opens wide and weak.

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Bell Atlantic Takes On Cable In Wireless Pact

BY MARY LU CARNEVALE
Staff Reporter

Bell Atlantic Corp. announced an alliance with a tiny New Jersey company to blanket the New York City area with an interactive, wireless television service that would compete with cable TV.

The alliance with **CellularVision of New York** Inc. will use an innovative microwave technology to compete head-to-head with cable systems in New York's five boroughs and three neighboring counties. Eventually, it could also compete with Nynex Corp.'s New York Telephone unit, offering an array of advanced telephone and data services.

The digital system punctures conventional wisdom that future multimedia services will be delivered over cable or phone wires into homes and businesses. It makes use of a flat, four-square-inch antenna that's mounted on a window and that costs about half as much to install as cable.

Nonetheless, Richard Aurelio, president of Time Warner Inc.'s Time Warner New York City Cable Group, said CellularVision's technology doesn't pose any immediate competitive threat. It has "severe limitations, including limited channel capacity and problems with signal quality and reliability," he said.

The new technology was invented by Bernard Bossard, a co-founder of CellularVision of New York. The Freehold, N.J., partnership includes real-estate developers Vahak Hovnanian and his son, Shant. Bell Atlantic holds a minority stake, and has a management contract to build and operate the TV service. Terms of the pact weren't disclosed.

A sister company, CellularVision Technologies & Telecommunications Inc., holds the patents on the new technology, which could open the way for local phone companies to provide two-way video services and other advanced telecommunications, including high-speed data services, movies on demand and video-teleconferencing services. In the future, it also could be used to provide ordinary phone service for residential and business customers.

For the next year or so, CellularVision of New York will be the sole user of the technology. Last December, CellularVision was awarded a special FCC license for pioneering the technology. The license covers operations in the five boroughs of New York, along with Westchester, Rockland and Putnam counties.

When it granted the license, the FCC proposed setting up a new telecommunications service using the 28 gigahertz band – a frequency that has been considered too high to be useful for commercial purposes. But the FCC is likely to take a year or so to adopt rules defining the new service and to set up procedures for auctioning the spectrum to companies that would build local systems.

Unlike cable TV, the CellularVision system sends TV signals through the air at very high frequencies – the 27.5 to 29.5 gigahertz microwave band. The network uses a series of transmitters, each of which is capable of broadcasting a digital signal within a six-mile radius. The signal is picked up at each subscriber's house by the window-mounted antenna, which is connected by coaxial cable – the type of wiring used by cable-TV companies – to a decoder that sits on top of the TV set. Although it could take hundreds of transmitters to serve the New York region, a microwave network would cost far less to build than stringing fiber-optic or coaxial cable past the homes or offices of every potential customer.

The partnership has been providing 49 channels of cable-TV programming, including some premium channels, to about 200 customers in Brooklyn's Brighton Beach neighborhood for $29.95 a month, substantially less than comparable cable-TV service. At a news conference announcing the partnership with Bell Atlantic, Shant Hovnanian said CellularVision would like to begin marketing the service next year.

The company's main focus so far this year has been finding a strategic partner, Mr. Hovnanian said. CellularVision now will turn to the task of developing a plan to roll out the service. "We plan to have the service available to as many areas as we can get to over the next two years," he said. A partner like Bell Atlantic, he said, will let the company build the network relatively quickly.

Brian Oliver, president of business development for Bell Atlantic's Bell Atlantic Enterprises International unit, declined to discuss the cost of building the New York system or to speculate on how long it might actually take. "We will develop plans, pursue the market based on those plans, take a look at where we are in two years," he said.

But Time Warner's Mr. Aurelio noted that "the high end of the frequency spectrum has never been used before for good reason," adding that the signal tends to fade in inclement weather. "CellularVision is claiming they've got some of these problems licked, but it is unproven," he said. Time Warner, along with U S West Inc., has embarked on a $5 billion project to upgrade its cable systems to provide interactive-TV and telephone services.

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Investor's Business Daily

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Will Cell Approach To Interactive Services Deliver Quality At Low Cost?

By Michael Stroud
In Los Angeles

Visionaries long have predicted interactive television would revolutionize home entertainment and business.

☑ Computers & Automation

By stringing fiber-optic cable to viewers' homes or workplaces, pundits say, the public will be able to access hundreds of TV channels, tap information services, conduct financial transactions and hold two-way videoconferences.

A key problem has been cost. Media giants Time Warner Inc. and Tele-Communications Inc. are spending billions of dollars to lay fiber. Customers ultimately will absorb that cost in their cable bills.

Last week, Bell Atlantic Corp. announced a partnership with a small private company called CellularVision of New York Inc. to pursue a radically different interactive TV approach in the New York area. The partners claim their system will cut costs substantially.

Instead of cable, the companies will transmit microwave signals through a network of cells similar to those employed by cellular phones. A television viewer will receive the signal on a small antenna mounted on a window. A cable will run from the antenna to the viewer's television set.

Reduced installation and maintenance costs already allow CellularVision to offer 41 cable television channels with wireless technology to 200 families in the New York suburb of Brighton Beach at 60% of the price of competing cable services, according to Shant Hovnanian, the company's chief executive.

The technology "solves a lot of the questions about how to get broad-band (video) services to the home affordably," Hovnanian said.

Bell Atlantic will operate and deploy the network of cells, which the companies plan to set up over the next year in five New York boroughs and nearby counties. Bell Atlantic also has taken a minority stake of undisclosed size in CellularVision.

CellularVision's technology eventually could compete with conventional telephone and data services.

'An Unproven Technology'

Cable companies aren't willing to throw in the towel.

Mike Luftman, a spokesman for Time Warner's cable unit, calls CellularVision's wireless approach "an unproven technology."

Luftman says images broadcast using CellularVision's technology are sometimes muddy. And he challenges Hovnanian's assertion that a microwave signal can carry as much data as an advanced cable line.

"They can overlook a lot of things, but they can't overlook the laws of physics," he said.

Time Warner already has an experimental cable service in New York offering far more channels than ordinary cable television. The company also is developing a fiber-optic system offering hundreds of channels in Orlando, Fla. The system will be the prototype for future Time Warner services nationwide.

Hovnanian insists the wireless system can handle the hundreds of channels that cable operators like Time Warner are planning for their customers. And he says the picture quality and reliability of his service matches or surpasses anything that cable operators offer.

During a recent Brighton storm, he observes, cable customers temporarily lost their service.

"We were the only ones left operating," he said.

Wireless "cable" is not a new concept. But supporters of the idea have been stymied by the tendency of high-frequency signals from nearby cells to overlap and interfere with each other.

CellularVision has a patented technology that it claims overcomes the problem. The technology was invented by Bernard Bossard, a CellularVision co-founder who is currently its chief engineering officer.

Ordinary cellular phones operate below the one gigahertz spectrum range. CellularVision's system operates at the superhigh 28 gigahertz range.

The Federal Communications Commission has granted the company a license in the New York area. The company says the FCC is expected to license the spectrum nationwide in coming months.

If the service rollout in New York is a success, CellularVision plans to expand into other markets.

Potential Customers

Hovnanian says CellularVision hopes to link different regions through interfaces with satellites and existing fiber-optic lines.

While home customers will be a strong focus of early marketing efforts, Hovnanian also is trying to stimulate interest among potential business customers.

CellularVision plans to test its product on Wall Street over the next year as an alternative to telecommunication services provided over fiber-optic cable. Teleconferencing, which the company already has demonstrated in Brighton Beach trials, is one potential early use.

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Enterprise Networking

Cellular technology may rival fiber-optic networks

By Joanie M. Wexler
WASHINGTON, D.C.

■ A high-speed cellular technology is emerging that could ultimately usurp fiber-optic cabling for carrying heavy-duty telecommunications applications. Its success, *however, hinges on a few regulatory "ifs."*

The Federal Communications Commission (FCC) this month approved the use of "CellularVision," a technology patented by CellularVision in Freehold, N.J., for running high-bandwidth applications over the nation's airwaves. Traffic traveling in CellularVision's 27.5- to 29.5-GHz FM radio band could include videoconferencing, high-definition television, medical imaging, multimedia and high-speed data, according to CellularVision inventor Bernard Bossard.

Bossard said uncompressed information could travel at about 1G bit/sec. and that the technology requires a transceiver and modem at each communicating site.

How the FCC will allocate the CellularVision spectrum remains a question--and one that will likely determine the usefulness of the technology to the business user. Benefits will depend on "how the FCC decides to divvy up licenses geographically, how many licenses are granted and how much spectrum each licensee gets," said Brian Moir, a partner at Fisher, Wayland, Cooper and Leader, a Washington, D.C., law firm that provides counsel to the International Communications Association user group.

Nationwide licensing

For example, if the FCC issued a single nationwide license, it would result in a seamless network for users, who would not have to contract with several carriers for interconnecting wireless segments. This could solve some of the problems faced by today's analog cellular telephone networks, where rates remain high because the spectrum is licensed in local chunks "and the interconnect charges between service areas are a fortune," Moir explained.

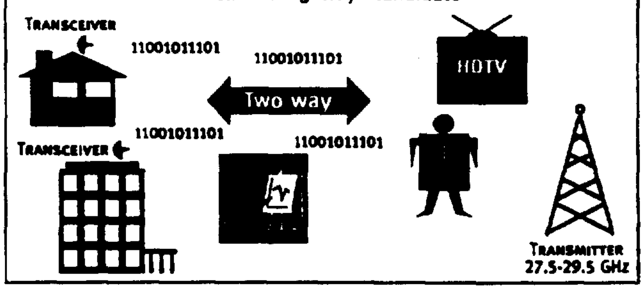
But the downside of a single license "is that the resources required to build a system like that [nationwide] are significantly higher," he said.

These issues parallel those with emerging personal communications networks (PCN), which will someday issue nomadic users a single, mobile phone number. One PCN proposal to the FCC from MCI Communications Corp. is to allocate spectrum to a small number of consortia nationwide in order to deliver both the seamlessness and the resources required to fund the network infrastructure [CW, Nov. 16].

Depending on how the specifics play out, CellularVision could fill a gap in the growing mobile computer market: Today's relatively slow (19.2K bit/sec.) wireless wide-area

Fiber challenge

CellularVision's broadband wireless technology: a new "electronic highway" candidate



CW Chart: Michael Siggins

networks are frustrating users who are accustomed to local-area network speeds. Also, users such as John Faccibene, vice president of telecommunications at Garban Ltd., a New York brokerage firm, said he sees CellularVision's capabilities as providing the bandwidth and flexibility for creating virtual offices or trading floors, particularly in a disaster recovery situation.

"During the floods here in New York City, a lot of companies lost their trading rooms," he said. "Imagine if they had ability to move to another location via wireless."

A high-speed wireless network could preclude the expensive and time-consuming task of laying fiber to all doorsteps to make services ubiquitous, added Andrew M. Seybold, publisher of the "Outlook on Computing" newsletter. He said that in an urban area, "cable is probably cheaper because I can run a cable down a major street and pull drops off of it. Each drop would be less expensive than having a separate transmitter and receiver at each user location."

However, he said, "the cable companies cannot make their systems two-way [interactive] without a tremendous upgrade."

Bossard said several Bell telephone companies have expressed interest in CellularVision. An Ameritech Co. spokesman confirmed that his company has "had some conversations with CellularVision, but it is too early to assess how it might fit into the overall scheme of wireless communications."

'Better' cellular

Each CellularVision cell spans 6 to 8 miles in diameter. When transmitting among cells, CellularVision reuses the same frequency so the full 2 GHz is continually available. This differs from today's analog cellular phone network, through which communications change frequencies from cell to cell. This reduces the amount of bandwidth available. CellularVision rivals fiber-optic capabilities, transporting traffic at 1G bit/sec. speeds.